

# MICROSCOPIC STUDY OF LEATHER DEFECTS

## III. STRUCTURAL CHANGES INDUCED BY FREEZEBRANDING\*

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### ABSTRACT

Super-chilled metal when properly applied to an animal's skin results in the production of a white-haired brand in the pattern of the branding instrument. Under ideal conditions only the epidermal pigment cells are destroyed, with little or no pain or permanent damage to the skin, and the regrowth of white hair appears to be permanent. Excessive freezing produces scarring and loss of hair.

A preliminary study was made of freezebranded cattle hides before and after tanning into side upper leather. When time and temperature conditions were severe enough to produce a bald brand, histological examination showed a deep-seated effect on fiber structure. Milder conditions, sufficient to produce a legible white-haired brand, caused only minimal changes that would constitute no serious impairment of leather properties.

Commercial processing and evaluation of 26 legibly branded sides showed a relatively high percentage of cuttability in the branded areas. A matched side test on an experimental cowhide, with a number of symmetrical brands of varying intensity, indicated that all but the most severe brands are readily concealed in black leather with corrected grain. Laboratory tests with the SATRA lastometer, in and around freezebranded areas of several leather samples, showed no significant reduction in grain strength, except where scarring was severe.

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Freezebranding offers some important advantages over the traditional firebranding, both to the tanner and to the livestock producer. Probably its greatest potential lies in the area of more comprehensive animal identification.



## INTRODUCTION

Defects in leather, many of which result in serious economic losses to the industry, stem from a wide variety of sources (1). The damage may occur before slaughter, between slaughter and the start of processing, or at some treatment stage in the tannery. The most elusive problems involve those conditions inherently present in hides or skins at the time of slaughter for which the basic cause is unknown. Veininess (2) and vertical fiber defect (3) have been dealt with in previous papers of this series; they are good examples of major problems in this category. It is most unfortunate that the man-made damage from hot branding irons, although well understood, continues to destroy large areas from the most desirable portions of countless hides. Substantial improvement of the situation is sorely needed.

The identification of animals has always presented problems. Ear tags, collars, tattoos, paints, chemicals and the use of hot branding irons have left much to be desired. Legibility at a distance and permanence of identity have been decisive factors in the continued hot-iron branding of cattle, not only on the open range but also in feedlot operations. Besides the inhumane aspects, firebranding exposes the animal to bacterial infection or screwworm infestation and, according to Potter (4, p. 16), induces damage to leather which causes an estimated annual loss to the tanning industry of some \$20 million.

A report (5) describing the destruction of pigment cells (melanocytes) in rat skin by extreme cold prompted one of us (R. K. F.) to explore the possibility of using freezing devices to decolorize the hair as a means of animal identification. First tests (6) were made on a dog in April, 1954, by applying a cube of solid CO<sub>2</sub> (dry ice). There was no expression of extreme pain as would be expected from hot-iron branding. After a few days there was evidence of a brand: hair loss, epithelial defoliation, and a scab in the center of the branded area. Although the dog was killed before regrowth of hair could occur, the results suggested that extreme cold rather than heat could be employed as a branding process.

It was not until May of 1965 (6) that a systematic approach was taken to study the various factors controlling the process. A comparison of brands on a dog was made using a small hot iron in the shape of an "H" and the same iron chilled to  $-70^{\circ}\text{C}$ . (dry ice-alcohol) and to  $-190^{\circ}\text{C}$ . (liquid nitrogen). The hot iron was applied instantaneously while the chilled irons were contacted to the clipped skin for eight seconds. All treatments produced visible marks. The

hot iron produced severe damage and resulted in a large area of scar tissue formation which rendered the "H" illegible. The chilled irons produced legible marks, with a regrowth of white hair and skin depigmentation at the brand site. However, the iron chilled to  $-190^{\circ}\text{C}$ . resulted in excessive hair loss and some permanent scarring. In spite of the damage, this type of bald brand can be utilized for identifying white-haired animals with good legibility.

These studies were later extended to include a number of cattle. More than forty of these branded hides were evaluated either in the laboratory or in a commercial tannery. Some representative results are given in the following report.

## EXPERIMENTAL METHODS

**Freezebranding.**—It is beyond the scope of this preliminary report to determine the tissue effects from any exact set of branding conditions. The work was exploratory in nature and some variations in technique occurred. In general the following conditions were used: branding instrument chilled† to about  $-70^{\circ}\text{C}$ .; brand site clipped and wet with alcohol; contact time about 20 to 30 seconds. Further information is given in the patent (7) that was recently issued on this process, in Hooven's account of his own preliminary trials (8), and in reports by Farrell (4, p. 5; 6).

**Histology.**—Routine procedures were used for preparing frozen sections, for staining sections and for microscopic evaluation, as outlined in the previous papers of this series (2, 3).

**Lastometer Tests.**—The SATRA Lastometer Mark II\*\* was used, according to method I.U.P. 9, of the official methods of the International Union of Leather Chemists Societies, where it is called the Ball Burst Test (9). It is essentially similar to the ALCA Method E 14 (10) and the ASTM Ball Burst (11). The ball diameter is 6.25 mm. and the leather specimen is moved down onto the ball at a different rate, but otherwise the tests are about the same. It is intended to simulate the multidirectional strain of leather stretched over the toe of a last, which stretches the grain more than the rest of the thickness and may cause the grain to crack. Acceptable values are given in the text.

## STRUCTURAL OBSERVATIONS

The structural changes described below fall into two categories: external — visual appearance of hide and leather surfaces; internal — microscopic appearance of cross sections. The extent of such changes is directly proportional to the severity

†A dry ice-alcohol bath is convenient, but temperature should be checked to guard against the warming effect which results from water absorption. The effect of this phenomenon was not fully appreciated in these early tests.

\*\*Mention of brand or firm names does not constitute an endorsement by the U. S. Department of Agriculture over others of a similar nature not mentioned.

of branding conditions. Three levels of intensity are described to indicate the range of damage that was observed.

The depth to which freezing occurs in the hide during branding largely determines the amount of permanent damage inflicted. Therefore the cellular epidermal system is of primary concern; this includes the surface epidermis and that which lines the hair follicles, as well as the hairs themselves and the sebaceous and sweat glands. As freezing progresses there is also damage to the underlying fibrous grain (papillary) layer and finally to the corium (reticular layer). Since the epidermal system is removed during processing into leather, damage to the fibrous layers (dermis) is of more practical concern to tanners. Hegreberg (4, p. 13) has noted that the dermal changes were not remarkable and there was no increase in thickness.

**Damage from Overbranding.**—When freezebranding is prolonged to the point of appreciable hair destruction there is likely to be a corresponding degree of permanent scarring as well. The external appearance of such a brand, as seen in the tannery, is shown in Figure 1. Legibility was good because enough long white hair remained to outline the numerals. A small sample was cut from the

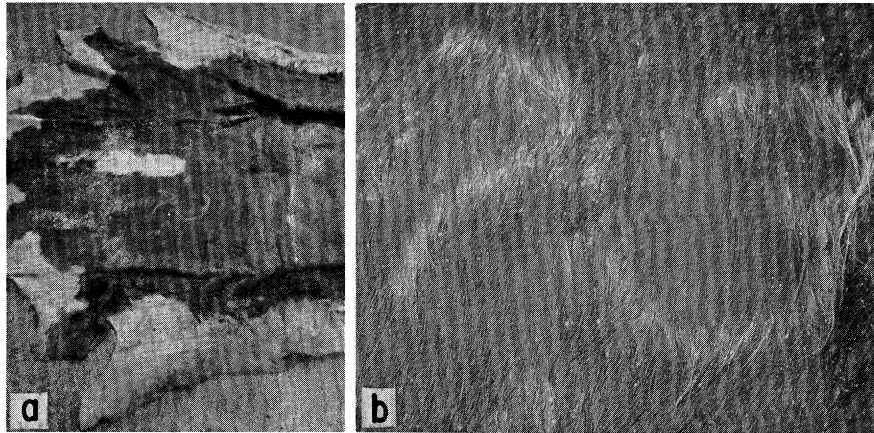


FIGURE 1.—Freezebranded hide, salt cured, as received in tannery: (a) distant view showing good legibility; (b) closeup view with long white hair obscuring baldness in numeral 7.

lower part of the numeral "7." Close inspection of this sample revealed that the central part of the numeral was quite bald, with a zone of white hair on either edge. The appearance of the leather made from this hide is shown in Figure 2a. Note the deep scar in the vicinity of the lower sample hole; this damage was so severe that the area would not be cuttable for shoes. In fact, the imprint of this numeral could also be seen clearly on the lower surface of the leather after splitting.

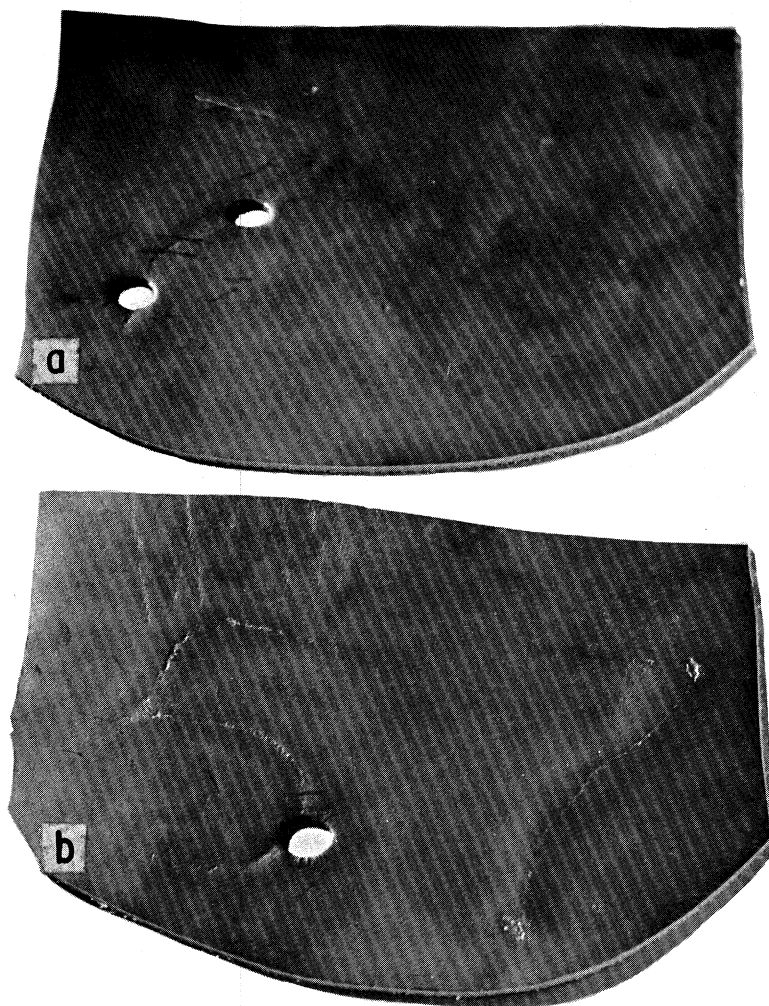


FIGURE 2.—Brand areas of finished leathers made from freezebranded hides: (a) #73, cross sections from the 7, lastometer tests on the 3; (b) #57, lastometer tests on the 7. Approximately one-fourth actual size.

Figure 3 shows how drastically the internal structure was altered in this bald brand. A cross section of the center of the brand in the hide (Fig. 3a) confirmed that the entire epidermal system had been destroyed. Healing produced a new layer of surface epidermis only. A compact layer of scar tissue in the grain layer tapered down into a central, root-like core which penetrated more than half the thickness of the hide.†† At the edge of the brand (Fig. 3b) there was a junctional region showing all three stages of freezing effects: no hairs sur-

††Hot-iron branding produces a similar result, except that the band of scar tissue is much wider and deeper, and the surface epidermis is greatly thickened.

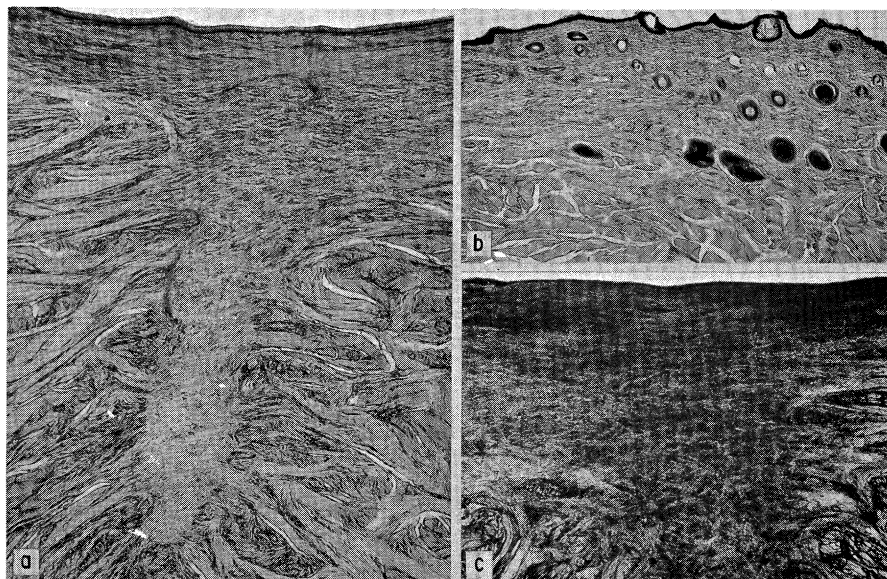


FIGURE 3.—Cross sections from the numeral 7 in freezebranded hide #73: (a) two-thirds thickness of cured hide at center of bald brand; (b) edge of brand showing no hair at left edge, white hair in center, colored hair at right; (c) leather section at center of brand. Sections a and b hematoxylin-eosin, c unstained, all approximately X 20.

vived at the extreme left (bald); white hairs were produced in the center; unchanged colored hair remained on the right. Leather sections (Fig. 3c) indicated that the abnormal fiber structure carried into the finished leather and the changes were drastic enough to influence leather properties.

**Variable Mild Damage.**—The majority of brands examined were noteworthy for their variations in intensity, both within the same numeral and between numerals of a pair. Figure 4 illustrates a typical brand of this type. Legibility in the hair (Fig. 4a) was excellent, and the depigmentation of the hide surface after unhairing (Fig. 4b) was still quite evident. However, from the appearance of the finished leather (Fig. 4c) one would think that the numeral "8" had been incompletely formed. (This leather was aniline-finished to bring out even the minor blemishes.) Evidently there had been uneven contact between the branding tool and the hide resulting in more pressure toward the right. A closer look at the original hide disclosed that most of the numeral "4" was partially bald while the "8" consisted of mostly intact white hair. The two numerals were sampled as indicated by the holes; adjacent leather samples were taken later.

Figure 5 shows the comparative structural changes in the hide that were associated with the two degrees of surface effect seen on the leather. In the numeral "4", which showed significant damage, cross sections (Fig. 5a) indicated a shal-

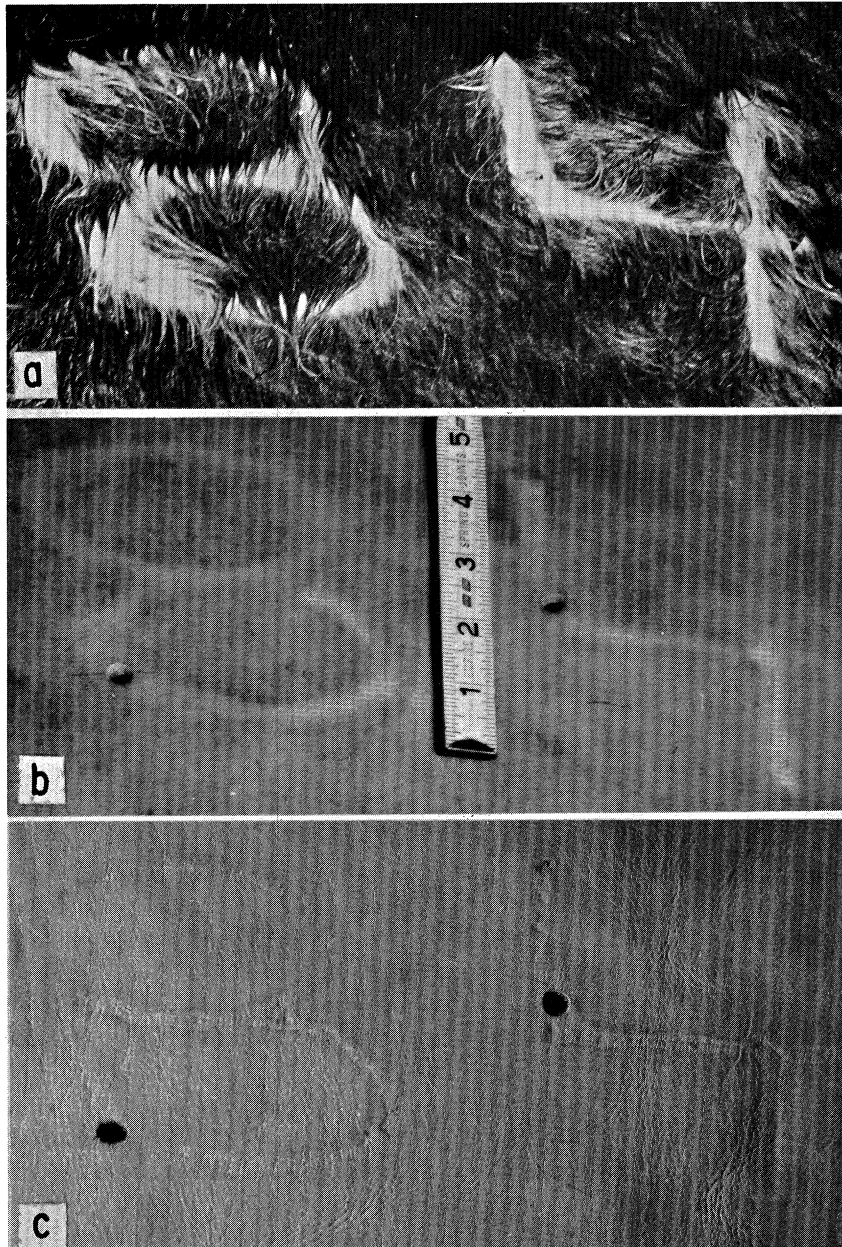


FIGURE 4.—Closeup views of freezebranded hide #84: (a) cured hide after washing; (b) grain surface after lime-sulfide unhairing; (c) grain surface of aniline-finished leather, with irregular mild damage in numeral 8, and scarring in numeral 4 after partial baldness.

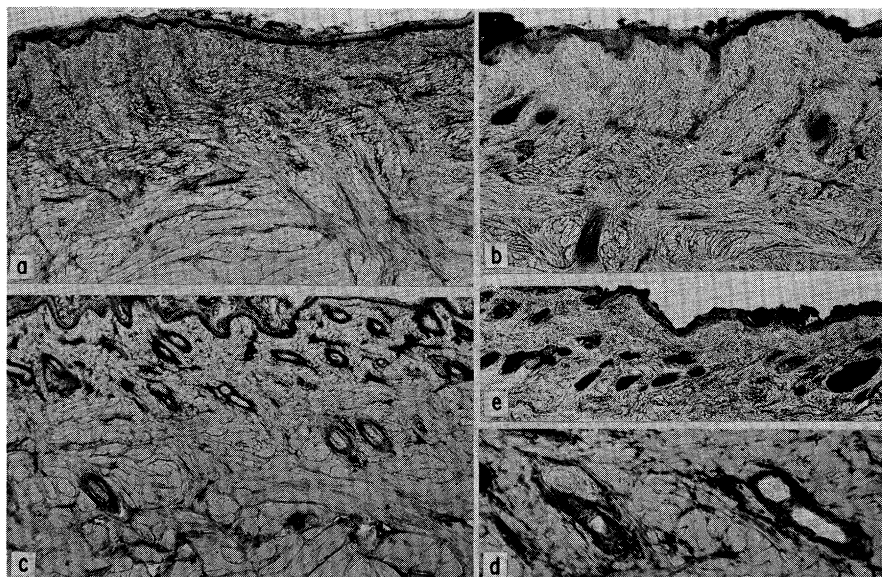


FIGURE 5.—Cross sections of cured hide #84, upper from the 4, lower from the 8 (see holes shown in Fig. 4): (a) elastic tissue stain showing shallow layer of scar tissue and absence of follicles; (b) fat stain showing a few surviving follicles; (c) hematoxylin stain showing essentially normal fiber structure; (d) portion of (c) at higher magnification showing abnormally stained sebaceous glands; (e) fat stain showing enlarged sebaceous gland. Section (d) approximately X 70, all others X 25.

low layer of abnormally dense fibrous tissue just below the surface epidermis. Some sections (Fig. 5b) also contained portions of surviving hair follicles. By comparison with the bald brand shown in Figure 3, the partially bald condition represents distinctly less damage both qualitatively and quantitatively. In the numeral "8," with no significant damage, the internal structure was almost normal. Besides the presence of white hairs the principal changes occurred in the glands (Fig. 5c). Sebaceous glands were often damaged (Fig. 5d) or modified in size or shape (Fig. 5e). Study of many sections failed to reveal any surviving sweat glands. There was also a barely perceptible modification of the uppermost portion of the grain layer.

Fiber structure in the leather, shown in Figure 6, can be more readily interpreted in terms of severity. In the numeral "4" (Fig. 6a) there was an obvious area of scar tissue which deepened toward the left side, but not as deep as that found in the bald brand (Fig. 3c). Higher magnification (Fig. 6b) showed the fibers to be thin and compactly arranged in a strictly parallel orientation. In the less damaged numeral "8" (Fig. 6c) the surface layer of modified fibers was relatively shallow and of uniform depth. More magnification (Fig. 6d) showed it to be a mat of finely interwoven fibers which would not be likely to exert a significant effect on leather properties.

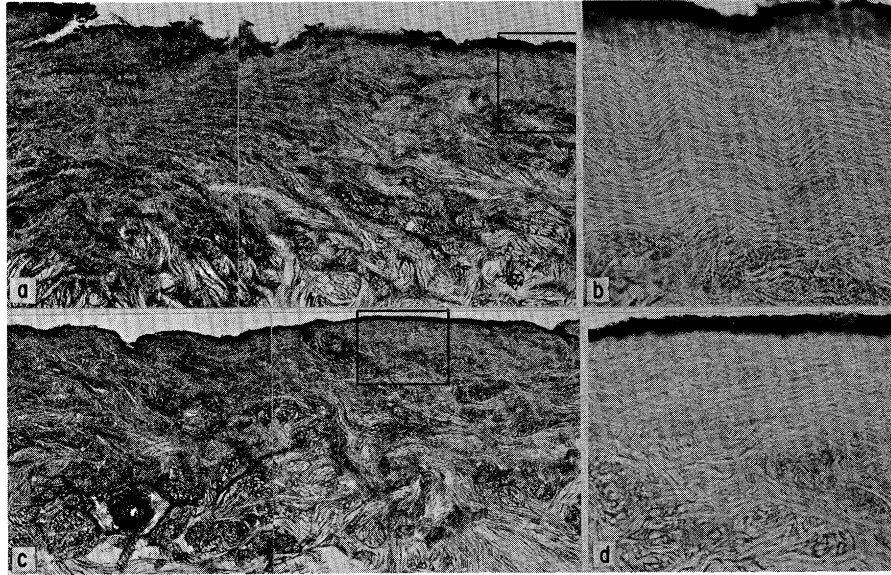


FIGURE 6.—Cross sections of leather #84, upper from the 4, lower from the 8: (a) variable layer of scar tissue and surface damage; (b) right-side portion of (a) at higher magnification showing altered diameter and orientation of fibers; (c) shallow layer of slightly modified fibers in grain layer; (d) center portion of (c) at higher magnification. All sections unstained, (a) and (c) X 20, (b) and (d) X 85.

**Progression of Freezing Effects.**—The preceding observations indicate the general range of tissue changes encountered. We have also observed a few ideal results in cowhide and horsehide where there was no detectable scarring whatever — the only change was destruction of pigment cells. These cells and the surface epidermal cells are the most sensitive to freezing. Next in order of sensitivity are the other elements of the epidermal system: first the sweat glands, then the sebaceous glands and finally the entire hair follicle. Of these cellular elements the healing process will replace only the surface epidermis. Accompanying the damage to sebaceous glands is the mild damage to the grain layer, while destruction of hair follicles implies serious damage extending into the corium. Healing will also replace damaged collagen fibers, but the replacement tissue is so different in architecture from the original that distortion (scarring) results. The fiber effects from milder damage can readily be seen in the leather cross sections of Figure 7. The decrease in severity, going from partially bald (Fig. 7a) to no hair destruction (Fig. 7b), further emphasizes the need for close control of branding conditions if the resultant leather is to be usable. The sections shown were stained for fat (dark areas) to illustrate how the scar tissue (right half of Fig. 7a) impedes the penetration of fat liquor.

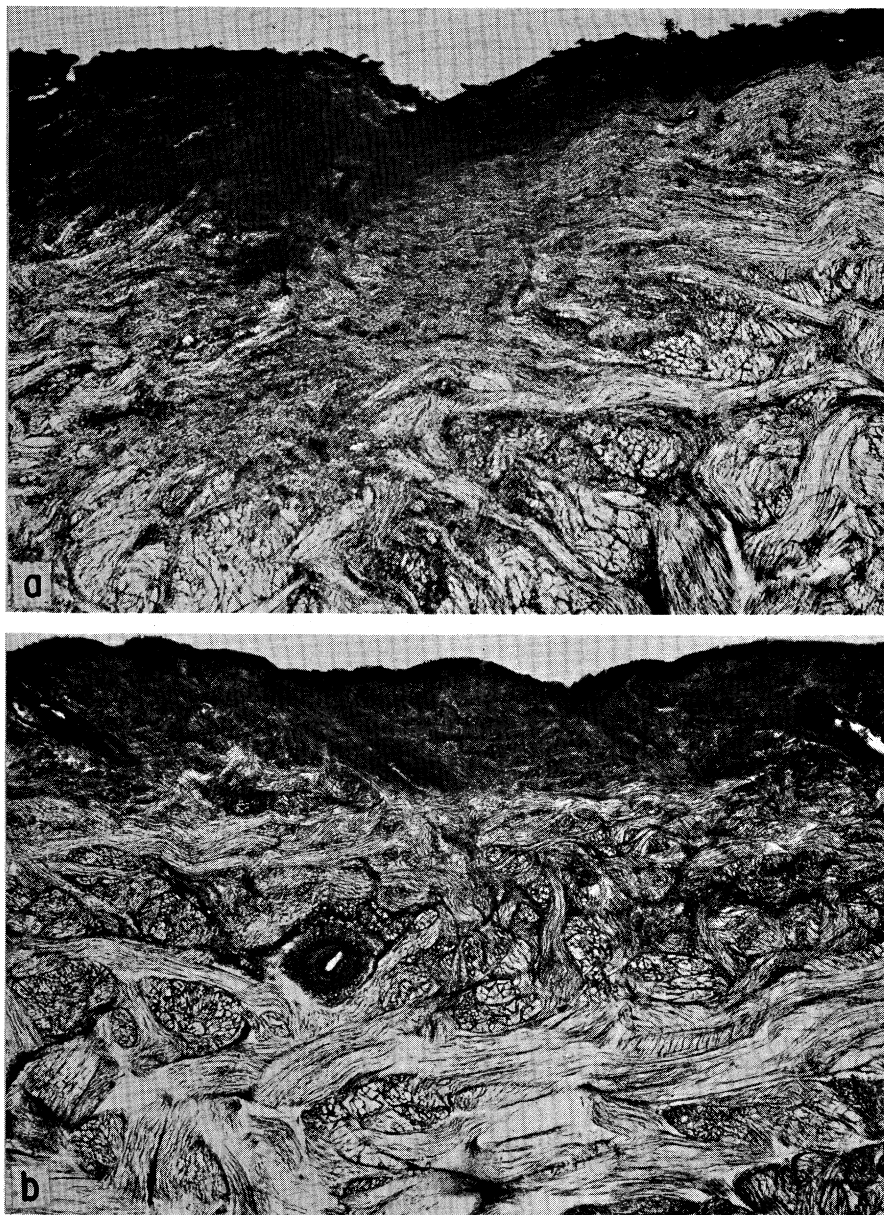


FIGURE 7.—Cross sections of leather #84 stained for fat, contrasting alteration of fat liquor penetration and fiber structure in partially bald brand (a) vs. essentially normal structure in brand (b) with intact hair.

## LEATHER EVALUATION

**Cuttability.**—A pilot-scale test was conducted in the fall of 1966 at a commercial tannery to evaluate the severity of grain damage induced by freeze-branding. A total of 37 branded sides was processed into combat boot upper leather (corrected grain finish), and each brand area was carefully evaluated for percentage of cuttability in three categories: completely cuttable; partially cuttable; not cuttable. Results are summarized in Table I, with the sides listed according to the legibility of their brands. As mentioned previously, considerable variation occurred in these early trials both within and between different brands. Six of the sides were underbranded and therefore must be disregarded. Five other sides were unevenly branded to the extent that the numerals could not be identified, and the one-sided pressure caused relatively severe damage. The main group of 26 sides with acceptable legibility gave very encouraging results: seven (27 percent) of the brand areas were cuttable leather while another eight (31 percent) were at least partially cuttable (variation within brand). Less than half of the brands (42 percent) were severely damaged. Contrasted with the situation in fire brands, where the brand areas are completely non-cuttable, this is certainly a substantial improvement.

TABLE I  
CUTTABILITY OF FREEZEBRANDED AREAS IN FINISHED  
LEATHERS WITH CORRECTED GRAIN

Brand* Clarity	No. of Sides	Completely Cuttable		Partially Cuttable		Not Cuttable	
		No.	%	No.	%	No.	%
Not visible	6	6	100	0	0	0	0
Sl. visible	5	1	20	1	20	3	60
Visible	26	7	27	8	31	11	42

\*Salt-cured hides in the hair.

**Grain Correction with Matched Sides.**—Corrected grain leathers have increased cuttability because the snuffing and finishing operations conceal minor blemishes completely and reduce the severity of many others. The efficacy of correcting the grain on freezebranded sides was further demonstrated in the following experiment. A black-haired cow had been literally covered with a series of small circular freezebrands for an experimental study of branding conditions. Seven vertical rows of brands were applied to each side of the cow, each row involving a different fluid medium for chilling the iron. Within each row the intensity was varied by increasing the contact time from 5 to 40 seconds at 5-second intervals; on the left side the intensity increased downward from the backbone while on the right it decreased downward.

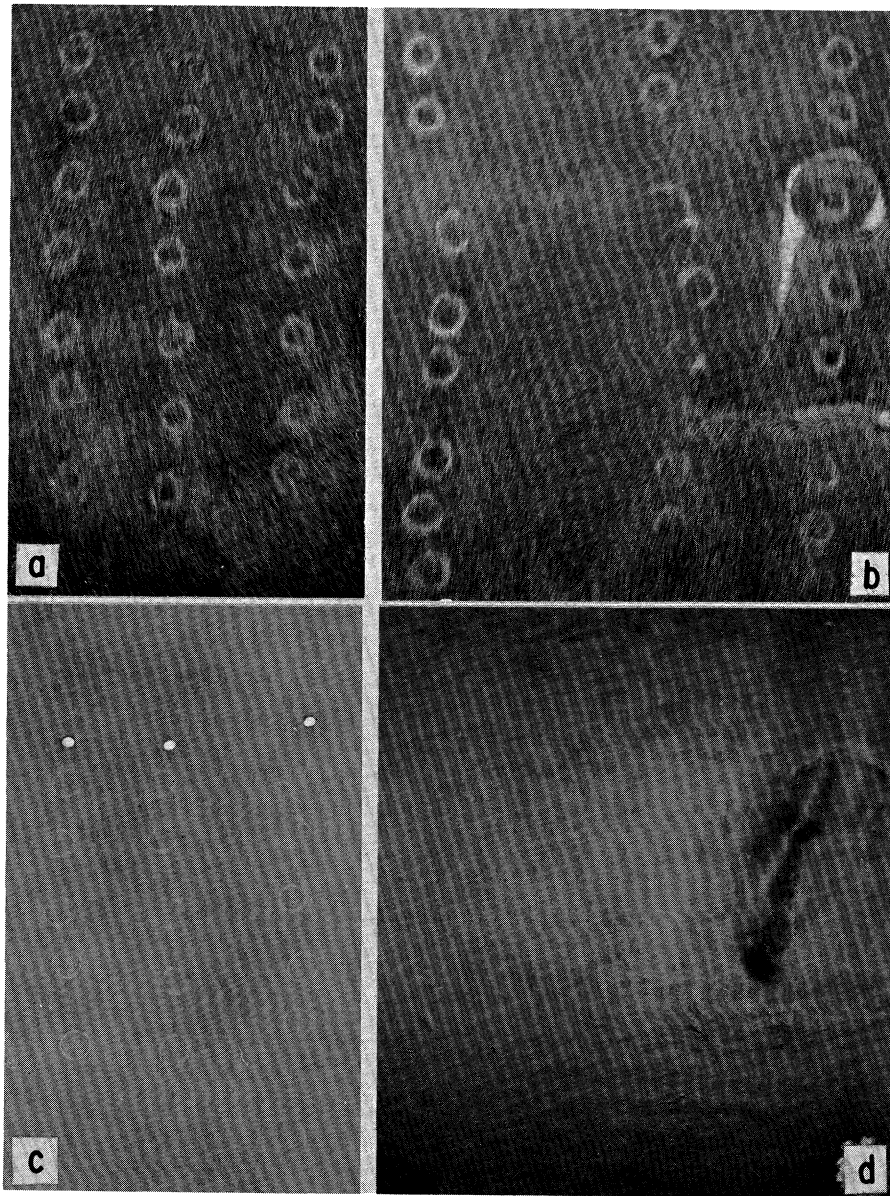


FIGURE 8.—Matched side test of grain damage from freezebranding. Upper figures show original appearance of near-center portions of washed sides, lower figures the resultant finished leathers, with left sides on the left and right sides on the right. Leather from left side (c) was aniline-finished, revealing brands; right side (d) had pigment finish on grain, concealing most brands.

After it was cut in half along the backbone the hide from this cow was processed in the laboratory to the pickled stage. The left side was sent to a cooperating tanner who converted it into upper leather with a light blue aniline finish, fully revealing all of the grain blemishes. The right side was sent to another tanner who made it into upper leather with corrected grain and black pigment finish. An ideal pair of matched sides was thereby provided to further evaluate the cuttability of freezebranded sides.

Figure 8 shows corresponding portions from the center of each of these sides; the appearance of the brands in the hair is shown in the upper figures (8a, 8b) and the grain surfaces of the resultant leathers below (8c, 8d). Note that spacing of the corresponding rows is somewhat different on the two sides so only the appropriate areas are shown, including a hot brand on the right. It is obvious that the aniline finish (Fig. 8c) is too revealing for these blemishes, but it provides a dramatic contrast to the covering power of grain correction with a pigment finish (Fig. 8d).

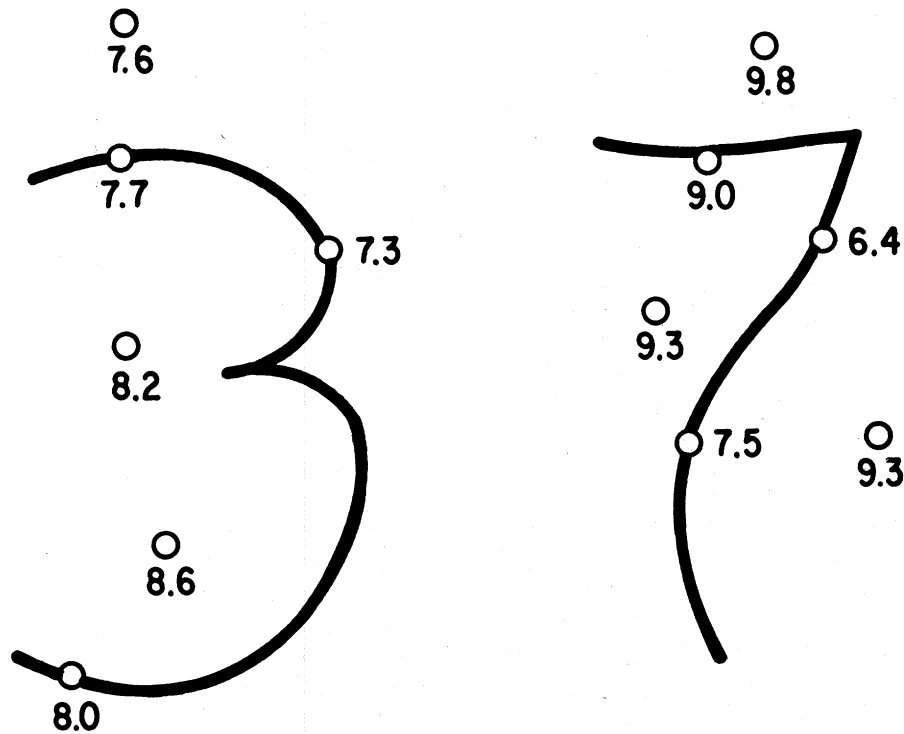


FIGURE 9.—Lastometer test results from two samples of leather from freezebranded hides (see Figure 2): numeral 3 from #73 and numeral 7 from #57. Circles represent test points and values represent mm. extension to grain crack.

**Grain Strength.**—It is well known that scratches or other defects in corrected grain leather can break open during the lasting operation in a shoe factory and result in “cripples” or rejected shoes. Therefore it was desirable to test some of the freezebranded areas in order to measure the extensibility of the grain and its resistance to cracking. Among several areas tested with the SATRA lastometer, representative results from two of them are reported below. Referring first to Figure 2, the areas tested were the numeral “3” in brand #73 and the numeral “7” in brand #57, of which the latter showed more severe grain damage. A diagrammatic summary of the results is given in Figure 9. Locations of test points, both within the brands and in nearby unbranded regions, are indicated by the circles. Values shown are expressed as mm. extension to grain crack. It is generally accepted that values below 6 are poor, while those above 7 are usually satisfactory. It can be seen that only one position gave a low value of 6.4; this was in the upper part of the numeral “7.” These preliminary results indicate that even where there is appreciable surface scarring, freezebrands in leather do not show excessive reduction in grain strength as measured by this test.

### DISCUSSION AND CONCLUSIONS

Freezing devices have long been used in human medical practice to produce controlled destruction of both superficial and deep-seated skin growths such as moles, warts, keloids and malignant tumors (12, 13). These and other biological uses of freezing have created a whole new field of “cryobiology” in modern research. It has been established that the critical temperature needed for cellular and tissue destruction is in the range of  $-18^{\circ}\text{C.}$  to  $-20^{\circ}\text{C.}$ , and some interesting studies on the temperatures produced by various devices at different depths in animal and human skin have been reported (12, 13, 14). It has even been shown (15) that topical treatment with a corticosteroid can decrease the amount of scar formation in a wound by inhibiting the growth and proliferation of fibroblasts. These few examples indicate that much pertinent research has already been done in other fields.

Freezebranding, or cryogenic branding, offers several important advantages over hot-iron branding. First, there is improved visibility and legibility of the brand. Less scarring results in uniform symbols with distinct boundaries and permits use of smaller brands. Second, the process is relatively painless and therefore completely humane. Minimal restraint of the animal and avoidance of shock are more considerate of the animal's well-being. Third, there is much less permanent damage to the hide and therefore a definite economic saving both to the hide supplier and to the tanner. One of the principal disadvantages is the added cost of the technique, since more time is required as well as more costly materials. At present there is also need for closer control of branding conditions in order to assure brand legibility and to minimize grain damage. Additional work is in progress elsewhere to establish optimum conditions. Overbranding to produce

baldness is necessary on white animals. Finally, a number of legal definitions and other technicalities will have to be resolved before the freezebrand will replace the hot brand for ownership purposes. All aspects of the problem were thoroughly discussed at a Freeze-Brand Seminar (4) held at Washington State University on May 17, 1966. For the most part it would seem that the advantages to be gained by this new method will far outweigh its disadvantages.

The ultimate utility and potential of freezebranding hinge on its newness. It is not encumbered by the limitations and conflicting restrictions imposed on fire-branding. The practicability of branding with small, legible symbols permits adapting the system to computer data processing techniques, making it ideally suited for widespread animal identification. For example, a four-digit code system has been proposed (16) utilizing the letters of the alphabet and the ten numerals. By arranging these symbols in different positions, this system provides at least six billion different combinations! This has tremendous implications to livestock growers for maintaining herd improvement and production records; to regulatory agencies for control and eradication of disease; and, theoretically at least, to the tanner for tracing the history of hides.

#### ACKNOWLEDGMENTS

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#### REFERENCES

1. Tancous, J. J., Roddy, W. T., and O'Flaherty, F. *Skin, Hide and Leather Defects*. Western Hills Publishing Co., Cincinnati, Ohio (1959). Distributed by the Tanners' Council Laboratory, University of Cincinnati, Cincinnati, Ohio 45221.
2. Everett, A. L., Willard, H. J., and Naghschi, J. *JALCA*, **61**, 112 (1966).
3. Everett, A. L., Willard, H. J., and Windus, W. *JALCA*, **62**, 25 (1967).
4. Proceedings, Freeze-Brand Seminar; Cooperative Extension Service, Washington State University, Pullman, Washington, May 17 (1966).
5. Taylor, C. A. *J. Exptl. Zool.*, **110**, 77 (1949).
6. Farrell, R. K., Koger, L. M., and Winward, L. D. *J. Amer. Vet. Med. Assoc.*, **149**, 745 (1966).
7. Farrell, R. K. U. S. Patent 3,362,381, Jan. 9 (1968).
8. Hooven, N. W., Jr. *J. Dairy Sci.*, **51**, 146 (1968).
9. *J. Soc. Leather Trades Chem.*, **44**, 371 (1960); official 1961, *ibid.*, **45**, 375.
10. Official Methods of Analysis, *ALCA* (1957). May be secured from the Secretary-Treasurer of ALCA, Tanners' Council Research Laboratory, University of Cincinnati, Cincinnati, Ohio 45221.
11. ASTM Standards, Part 15 (1967), D 2207-64.

12. Grimmett, R. H. *Arch. Dermatol.*, 83, 563 (1961).
13. Zacarian, S. A. and Adham, M. I. *Cryobiology*, 2, 212 (1966).
14. Zacarian, S. A. and Adham, M. I. *J. Invest. Dermatol.*, 48, 7 (1967).
15. Berliner, D. L., Williams, R. J., Taylor, G. N., and Nabors, C. J. *Surgery*, 61, 619 (1967).
16. Anon. *Idaho Farmer*; p. 26, Jan. 5 (1967).

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#### DISCUSSION

DR. LOLLAR: Jean Tancous is the discussion leader on this paper, Jean.

MRS. TANCOUS: These worthwhile studies presented by Mr. Everett are encouraging to all of us, because they indicate that the damage to leather due to brands can be reduced and possibly eliminated.

A specimen of a hide showing eight circular freezebrands was sent to us by Doctor Farrell, one of the authors of the paper. It was a rare specimen since it was the first polka dotted Holstein hide that we had seen.

The circles of white hair are, as you will agree, a striking aspect of this type of branding.

The brands we had examined in most instances, caused scars but none was as severe as a scar from a hot iron brand.

As evidenced by Mr. Everett's slides there have been improvements in techniques since that time. We certainly hope that the freezebranding is the answer to eliminating the identification marks made with hot irons that are so costly to the hide and leather industry.

I have several questions to ask Mr. Everett. First of all, how long does it take for the white hair to appear?

MR. EVERETT: As far as I know it takes up to about four months in cold weather and somewhat less than this during the warm weather to get a new cycle of hair growth that will be white after branding.

MRS. TANCOUS: In the actual use of a brand, how soon after the brand is applied is it needed for identification?

MR. EVERETT: It is true that you don't get the permanent white brand until this approximately four month period, but immediately after branding there is a swollen, reddening reaction and then following this the hair falls out. So you have a temporary bald brand until the white hair grows in finally, three or four months later.

So it is a readable brand practically from the start.

MRS. TANCOUS: How long is this brand going to last? How many shedding cycles?

MR. EVERETT: That's a loaded question because this work is still early and as far as I know the animals haven't been observed over a year.

But it seems safe to assume that if they go through two or three hair cycles it will continue permanently.

MRS. TANCOS: I understand that Doctor Farrell has branded himself. Do you think this hurt at the time he applied the brand, or was there pain afterwards while the scar tissue was developing? In the case of his brand I suppose he had some scar tissue.

MR. EVERETT: He did have a little mark from it but we were willing to take his word for it about the absence of pain; I'm sure he was right.

While he could no doubt sense it, as you can sense any cold object, I don't think it would be pain anywhere near like cutting yourself or anything like a hot brand, certainly.

I would say it would be more in the area of discomfort rather than pain. I'm only guessing, of course.

MRS. TANCOS: Are there any questions from the floor? If there are no questions then we will thank Mr. Everett again for his worthwhile paper.